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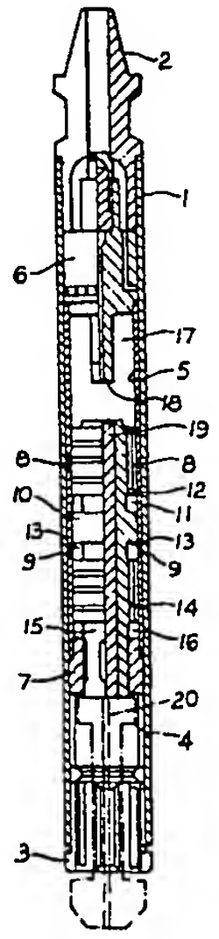
(54) Percussive drills.

(57) The invention relates to percussive drills for earth boring, and particularly to so-called valveless drills. In such drills it is important to allow, cyclically, compressed air to pass into the bore hole to clear debris through a central hole in the bit which central hole needs to be closed to allow the return stroke of the piston. This has been provided for hitherto by a short tube usually of plastics material, secured to the innermost end of the bit so that as the piston approaches the bit on the drive stroke the tube engages in a counterbore in the piston to seal the bore through the bit. Such short tubes are frequently damaged causing cessation of operation of the drill whilst down the hole, a circumstance that is to be avoided. The objective of the invention is to avoid the above disadvantage, which objective is met by a construction comprising an outer wear tube (1), compressed air inlet means (2) to one end of the wear tube, chuck means (3) for holding a drill bit (4) to the opposite end of the wear tube, a cylinder (5) located within the wear tube with an annular gap therebetween, an air diverter (6) located at the end of the cylinder towards the air inlet, a sealing bearing (7) located at theend of the cylinder towards the chuck, and a piston (10) within the cylinder, said piston having a portion (15) of reduced diameter adapted to pass through the sealing bearing to strike a bit held in the chuck, and there being porting (8, 9) to direct air to one side or the other of the piston to provide a drive and a return stroke.



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This invention relates to earth boring equipment, and is particularly concerned with the type including a percussive drill.

Hitherto, percussive drills for earth boring equiment have been of two major types, both driven by compressed air, so-called valved and so-called valveless drills. Thus, in valved drills, a piston is provided within a cylinder, above which is a valve seat provided with port holes to direct compressed air either to the side of the piston to cause an up or return stroke or to the side of the piston to cause a down or drive stroke, as is dictated by a flap valve associated with the valve seat. Such percussive drills are perfectly adequate for low air pressure drills although ingress of dirt can be a major problem should it pass below the flap valve and prevent the effective shut-off of air supply to one side or the other of the piston. With valveless drills, which are far better suited to high pressure applications, a combination of ports closable by the piston itself are provided, and with air passageways extending through the piston, pressure air can be directed to one side of the piston to provide an up or return stroke, or to the other side of the piston to provide a down or drive stroke. With both

versions, a drill bit is struck by the piston at the end of the drive stroke, the drill bit being held in a chuck at the end of a wear sleeve surrounding the cylinder.

Of particular importance in valveless percussive drills is the fact that a central bore is provided through the drill bit, so that compressed air can cyclically be passed into the bore hole to clear debris from around the drill bit, and encourage its passage up the bore hole outside the wear tube. Thus, as, or immediately prior to, the piston striking the bit, compressed air is fed to the cylinder beyond the piston in the direction of the drill bit, to provide the force for the up or return stroke. Because of the central bore through the bit, this would escape into the bore hole through the bit, and accordingly it has been the practice to provide a relatively short plastics tube secured to the innermost end of the bit so that as the piston approaches the bit on the drive stroke the tube engages in a counterbore in the piston to seal the bore through the bit, and allow the compressed air supplied to that side of the cylinder to provide the force required for the return stroke.

It will readily be understood that any

damage to the plastics tube will render the drill ineffective, and as the drill is at the bottom of the bore hole, the drill and its feed tubes must be withdrawn to allow repair or replacement of the tube. This occurs relatively frequently, and causes major, and expensive delays in drilling operations.

The object of the invention is to provide earth boring equipment with percussive drills of the valveless type which eliminates the above-mentioned disadvantages.

According to the present invention, a valveless percussive drill for earth boring equipment comprises an outer wear tube, compressed air inlet means to one end of the wear tube, chuck means for holding a drill bit to the opposite end of the wear tube, a cylinder located within the wear tube with an annular gap therebetween, an air diverter located at the end of the cylinder towards the air inlet, a sealing bearing located at the end of the cylinder towards the chuck, and a piston within the cylinder, said piston having a portion of reduced diameter adapted to pass through the sealing bearing to strike a bit held in the chuck, and there being porting to direct air to one side or the other of the piston to provide a drive and a

return stroke.

Thus, by providing a portion of reduced section at the end of the piston that extends into the sealing bearing towards the end of the drive stroke, the chamber formed between the piston and the cylinder at that end is effectively sealed from the bore through the drill bit by relatively simply, highly efficient and robust means, thereby avoiding completely a source of repeated drill failures in prior constructions.

For simplicity and to highlight other aspects of the invention, one example of valveless percussive drill bit for earth boring equiment is illustrated in the accompanying drawing which is a part sectional side elevation through a valveless percussive drill bit of the invention.

In the drawing a valveless percussive drill bit has an outer wear tube 1 provided at one end with a compressed air inlet or backhead 2 and at the opposite end is a chuck 3 in which is secured a drill bit 4.

Located within the wear tube 1 is a cylinder 5, there being between the cylinder and the wear tube an annular gap of approximately 0.075 inches. At the inlet end, a diverter block 6 is provided to allow compressed air to pass from the

inlet 2 to the annular gap between the cylinder and the wear tube, and at the opposite end of the cylinder an integral sealing bearing 7 is provided.

Spaced along the length of the cylinder 5 are two sets of ports 8 and 9, and within the cylinder there is provided a piston 10 having a first groove 11 associated with air passageways 12 and a second groove 13 associated with air passageways 14. At the end of the piston towards the sealing bearing 7, there is provided a projection portion 15 of reduced diameter, and of a diameter to constitute a sliding fit within the sealing bearing.

Thus in the absence of pressure air and with the percussive drill held in a generally upright condition with the chuck lowermost, the inertia in the piston will bring it down the cylinder until such time as the end of the portion of reduced diameter is in contact with the end of the drill bit 4. In this condition the groove 13 in the piston is aligned with the inlet ports 9, and at the onset of pressure air, it is directed through the diverter 6 down the annular gap, through the ports 9 and along the air passageways 14 into a chamber 16 formed between the projecting portion 15 of the piston, the integral bearing 7

and the cylinder 5. This applies an upward force on the piston to drive the piston upwardly of the cylinder. The longitudinal spacing between the inlet ports 8 and 9 and the grooves 11 and 13 is such that the grooves 13 clear the ports 9 before the grooves 11 reach the ports 8 and when compressed air is shut-off from the piston. However the expansion of air in the chamber 16 and the inertia in the piston allows it to complete its return stroke. As the piston approaches the end of its return stroke, but before the end of the return stroke, the groove 11 reaches the ports 8 thereby allowing progressive application of compressed air to a chamber 17 formed between the piston, the cylinder and the diverter block 6. As the end of the return stroke is reached, a projection 18 on the diverter block enters into a central bore 19 through the piston and the then sealed chamber 17 allows the further compression of air in the cylinder to cushion the end of the return stroke and prevent the piston from striking the diverter block 6. The piston is then primed for the drive stroke and the compressed air together with the inertia of the piston drives the piston downwards until the groove 11 clears the ports 8 thereby shutting-off the supply of compressed air to the

chamber 17. This occurs before the groove 13 has reached the ports 9 when again compressed air supply is shut-off from the piston, the expansion of air in the chamber 17 and the interia of the piston allowing it to complete its drive stroke. As the piston approaches the end of its drive stroke the groove 13 firstly overlaps the ports 9 and then becomes aligned with the ports 9 to allow the progressive appication of compressed air through the passageways 14 to the chamber 16 by when the projection 15 on the piston has entered the sealing bearing 7, allowing the further compression of air in the now sealed chamber 16 to cushion the piston as it approaches the end of its drive stroke but not to such an extent as would prevent the end of the projection 15 from striking the end of the drill bit 4. Towards the end of the drive stroke the projection 18 on the diverter block 6 clears the bore 19 through the piston allowing the release of compressed air through the bore 19 through an aligned bore 20 in the drill bit and out into the bore hole. This not only permits the start of the return stroke but also has the effect of clearing debris from around the drill bit and encouraging the passage of debris up the bore hole to the outside of the wear tube.

The relationship between the total area provided by the ports 8 and the ports 9 in relationship to the annular gap between the cylinder and the wear tube is important for optimum effect but is not critical. What is most important is that the length in the longitudinal direction and the area of the ports 8 are greater than those of the ports 9. This is to allow a greater and more prolonged application of compressed air to the chamber 17 than to the chamber 16 because of the greater surface area of piston that has to be acted on by compressed air at that end.

CLAIMS

1. A valveless percussive drill for earth boring equipment comprising an outer wear tube (1), compressed air inlet means (2) to one end of the wear tube, chuck means (3) for holding a drill bit (4) to the opposite end of the wear tube, a cylinder (5) located within the wear tube with an annular gap therebetween, an air diverter (6) located at the end of the cylinder towards the air inlet, a sealing bearing (7) located at the end of the cylinder towards the chuck, and a piston (10) within the cylinder, said piston having a portion (15) of reduced diameter adapted to pass through the sealing bearing to strike a bit held in the chuck, and there being porting (8,9) to direct air to one side or the other of the piston to provide a drive and a return stroke.

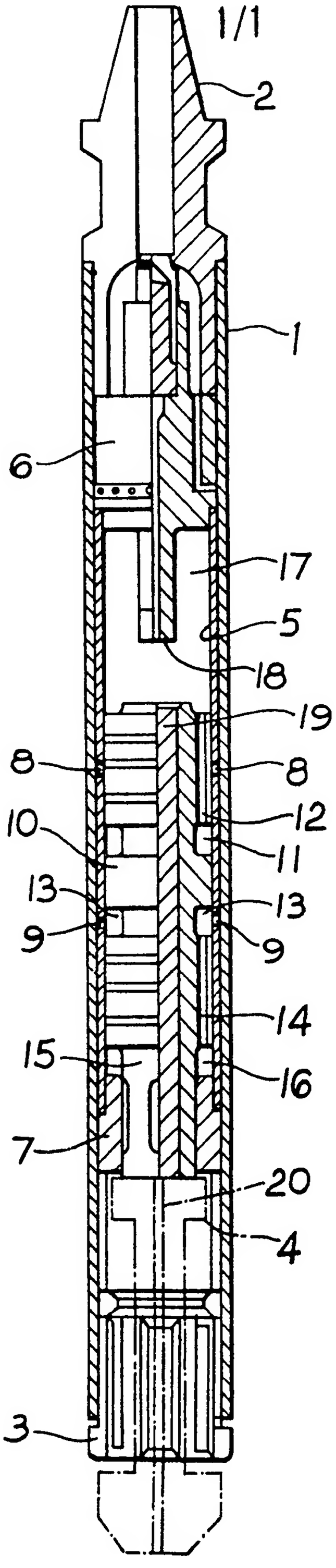
2. A valveless percussive drill for earth boring equipment as in Claim 1, wherein the annular gap between the wear tube (1) and the cylinder (5) is 0.075 inches.

3. A valveless percussive drill for earth boring equipment as in Claim 1 or Claim 2, wherein the position of the ports (9) is such that with the piston (10) in contact with the bit (4), the ports (9) are aligned with a groove (13) in the piston,

having an associated passageway (14) to direct pressure air to a chamber (16) formed between the cylinder (5) the portion (15) of the piston and the bearing (7).

4. A valveless percussive drill for earth boring equipment as in any of Claims 1 to 3, wherein the position of the ports (8) is such that with the piston (10) at the end of its return stroke, the ports (8) are aligned with a groove (11) in the piston having an associated passageway (12) to direct pressure air to a chamber (17) between the piston, the cylinder and the diverter block.

5. A valveless percussive drill for earth boring equipment as in any of Claims 1 to 4, wherein the length in the longitudinal direction between the ports (8,9) and the area of the ports (8,9) is such that a greater and more prolonged application of compressed to the chamber (17) than to the chamber (16) is provided to compensate for the greater surface area of piston that has to be acted on by compressed air at that end.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EUROPEAN SEARCH REPORT

Application number

EP 82 30 4174

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
	---		E 21 B 4/14
A	US-A-3 503 459 (M.E.SCHINDLER) *Column 2, line 45 to column 6, line 2; figures 1A-8*	1,3,4	

A	US-A-4 163 478 (G.L.ADCOCK) *Column 1, line 60 to column 4, line 39; figures 1-4*	1,3,4	

A	US-A-4 098 352 (J.F.KITA) *Column 2, lines 40-54; figures 1,2*	1,3	

A	FR-A-1 509 142 (SAFAS) *The whole document*	1	

A	FR-A-2 140 700 (FRANKFURTER MASCHINEN BAU) *Page 5, line 16 - page 7, line 2; figures 1,2*	1	TECHNICAL FIELDS SEARCHED (Int. Cl. ³)
	---		E 21 B E 21 C
A	EP-A-0 040 026 (HALIFAX TOOL) *Page 10, lines 14-34; figure 9*	1	

A	US-A-4 030 554 (A.W.KAMMERER)		

A	US-A-4 084 647 (W.LISTER)		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	06-01-1983	JAUNEZ X.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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